"Hush it up!": Silence as a Pedagogical Resource in a Language Immersion Mathematics Classroom

José Martínez Hinestroza
Texas State University

Abstract

Frequently, the silence of students whose first language is not the language of instruction is interpreted as indicative of lack of knowledge or language proficiency. I propose an alternative interpretation, illustrating how both teacher and student silence can be a pedagogical resource that respects students' sense-making, honors the multimodal nature of mathematical activity, and follows principles from research on second language learning. I draw on an example from a geometry task in a third-grade Spanish immersion classroom and invite readers to consider how teachers and students can use silence as a pedagogical resource in their bilingual contexts.

Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

1. How do you interpret student silence during mathematics class discussions and small group work?
2. What productive roles can silence play in mathematical activity, especially for multilingual students?
3. What productive roles can teacher silence play in mathematical activity?

José Martínez Hinestroza (josemartinez@txstate.edu) is an assistant professor of elementary mathematics education in the Department of Curriculum and Instruction at Texas State University. José is a former school teacher and academic coordinator in Colombia. His participatory research focuses on how students, teachers, and researchers collaborate to develop inclusive bilingual mathematics classrooms.

"Hush it up!": Silence as a Pedagogical Resource in a Language Immersion Mathematics Classroom

José Martínez Hinestroza

Including all students in the exploration of meaningful ideas is an enduring issue in mathematics education. Addressing this issue is particularly complex when working with bilingual students, as students who are proficient in the language of instruction tend to dominate discussions. Initially, that seemed to be the case in a Spanish-immersion classroom that I regularly visited as part of my collaboration with a third-grade teacher, Mrs. Abad (all names are pseudonyms). During one of my visists to this classroom as a participant observer, Mrs. Abad approached a small group and asked students to share ideas about the problem they were solving. One of the students, Haley, quickly raised her hand and immediately started talking. Mrs. Abad acknowledged Haley's strategy and asked for other ideas. After a brief silence, Haley proceeded to explain a second strategy. Mrs. Abad asked if anyone else had ideas to share. There was no response.

When Mrs. Abad and I discussed this and similar episodes, we concluded that we needed to develop teaching strategies to help all students engage with mathematics tasks. We looked for these teaching strategies in previous research on mathematics education in classrooms where students' first language is different from the language of instruction. The strategies we used included providing comprehensible input (Li, 2015), using visual representations (Escobar Urmeneta, 2013), and using multiple languages strategically (Martínez Hinestroza, 2018).

Although these strategies facilitated communication of mathematical ideas, this approach to supporting bilingual students overemphasized the teacher's and the students' language production. After all, the motivation driving these efforts was to *hear* ideas from all students during discussions. An alternative motivation that mitigated the tendency to overplay the role of spoken contributions is to *support all students' mathematical sense-making*. This is a subtle but important shift from considering student talk as the ultimate goal to considering it part of the multimodal process of exploring mathematical ideas. Other modalities involved in this process include gesturing, representing with symbols, drawing, and writing (O'Halloran, 2005).

In addition to these modalities, mathematical sense-making "also includes silences. Like in a piece of music, far from being accessorial, silence plays a crucial role: It is a constitutive part of the text" (Radford et al., 2007, p. 517). However, silence—defined as the absence of spoken utterances—is often vilified and related to an undesirable stage where students passively receive knowledge established by others (Becker, 1995). Student silence is equated with lack of confidence and it is seen as a symptom of marginalizing classroom cultures (Foote & Lambert, 2011; Lubienski, 2000). This was how Mrs. Abad and I initially interpreted the example above. Although still vigilant about silence that isolated students and hindered sense-making, over time we shifted our focus: We considered *student silence* that opened up opportunities to use multiple modalities and *teacher silence* that allowed for students to author mathematical ideas.

In this paper, I describe a geometry task that drew on these kinds of silence in a Spanish-immersion third-grade classroom. I discuss how drawing on silence was respectful of students' diverse sense-making, honored the multimodal nature of mathematical activity, and was consistent with research on second language learning. First, I describe the classroom and lesson context. Then, I illustrate how both student and teacher silence served as pedagogical resources.

The Context

The example I present comes from a third-grade classroom in the Midwestern US. This classroom was part of a language enrichment (Brisk, 2011) Spanish-immersion program. Spanish was the language of instruction for most of the day (all but one lesson a day was in Spanish), including mathematics lessons. There were 21 students in the classroom, most of whom (18

students) spoke English at home and were learning Spanish as a second language at school. The other three students spoke both Spanish and English at home. All students understood directions and followed conversations both in Spanish and English, and there were variations in students' Spanish speaking skills. Mrs. Abad was the Latina, Spanish-English bilingual teacher. I, a Latino, Spanish-English bilingual researcher and teacher educator, visited this classroom at least once a week and worked closely with the teacher for over three years.

The Mystery Shapes Task

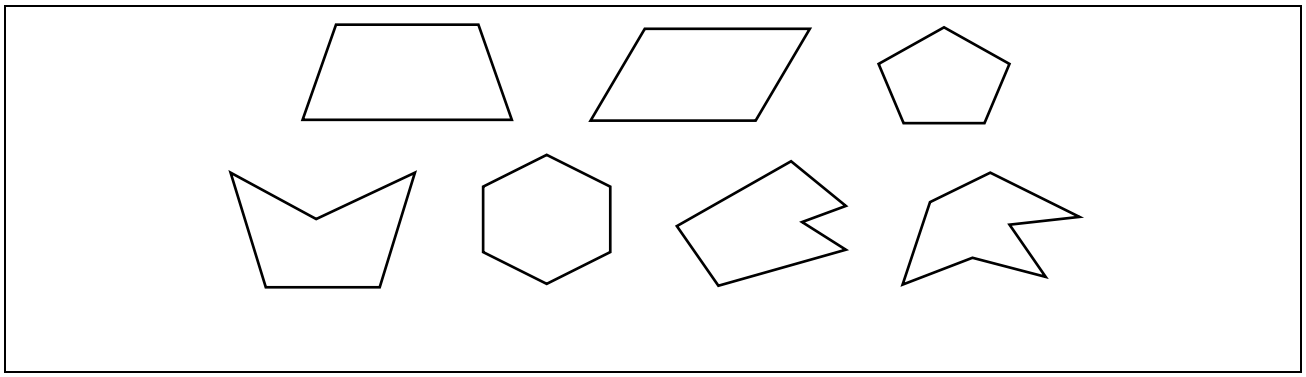
The mystery shapes task took place at the beginning of a geometry unit in the last quarter of the 2017-18 school year. The mathematical objectives were: (1) to identify defining attributes of 2D shapes, and (2) to build specific 2D shapes. The language objective was to use complete sentences to name and describe objects. Relating the mathematics and language objectives involved: (1) describing 2D shapes using informal language, and (2) using progressively more precise language to name 2D shapes and describe their defining attributes. There were two parts in this task. During the first part, students worked in groups of three. Each group selected a representative and the teacher and I shared directions with the representatives only. After representatives observed all the shapes in Figure 1, we assigned one of the shapes to each group. Only the representative, and not other group members, could see the shape throughout the task.

Representatives worked with their groups so that each group member could build the shape using pipe cleaners. Representatives could talk, gesture, and show the shape using objects (such as a pipe cleaner), but there were two restrictions: First, we asked representatives not to draw the shape. Second, we asked that no one touch anyone else's pipe cleaners. That is, once a student started working with a pipe cleaner, only that student could move, fold, or rearrange that pipe cleaner. These restrictions were intended to foster the use of multiple modalities. The teacher and I anticipated that representatives would use a combination of spoken language, gesturing, and manipulation of a pipe cleaner to make sense of the defining attributes of their shape and to communicate with their group. We anticipated that other group members would use a combination of listening, spoken language, observation, and manipulation of the pipe cleaner to build the shape. Rather than interpreting observation as meaningless imitation, multimodality fostered silence that made room for visualization and embodied sense-making.

The second part of the task was a whole class discussion where each group shared their shape with the rest of the class. The class discussed commonalities and differences among the shapes and ways of categorizing the shapes. In both parts of the task, the teacher and I intended to draw upon our own silence. Instead of telling students what to do, or guiding their exploration through questioning, we intended to unobtrusively and quietly observe. Our silence helped us to not take over children's ideas, while we made sense of students' problem-solving strategies.

Figure 1

Shapes included in the mystery shapes task.



This task was informed by the information gap tasks (commonly called 'info gaps' by educators) used in world languages classrooms that focus on communicative skills (Larsen-Freeman, 2011). In info gaps, students work together to complete a task but each student is missing some of the necessary information. Students communicate to fill in the gaps so that they all have all the information. In the mystery shapes task, each group representative had all the necessary information. They needed to communicate with the other two group members to share information that would allow all three students to build the shape. We adapted this kind of task to foster multimodality, including silence, instead of overemphasizing spoken communication.

From a language teaching standpoint, info gaps foster authentic communication that focuses on meaning. Communication is authentic because the students are interacting to find out information they need. The focus is on meaning because students use language to convey the necessary information, even if there are language inaccuracies. From a mathematics teaching standpoint, the mystery shapes task focused on relevant attributes of a shape. As the task unfolded, multiple modalities involved in mathematical activity emerged, including observation, gestures, and manipulation of the pipe cleaners. Student and teacher silence also emerged as important pedagogical resources supporting sense-making, as I describe next.

Silence Supporting Mathematical Activity

The following transcript illustrates how student and teacher silence emerged as an important pedagogical resource to support these bilingual students. The three students in this group (Willie, Calum, and Jimmy) all spoke English at home and Spanish was their second language. After listening to the directions, Willie, the group representative, explained the task to Calum and Jimmy. He then tried to describe the assigned shape, the convex hexagon in Figure 1. In the transcript, my English translation is italicized.

Table 1
Silence during mathematical activity

Student	Utterances	Non-spoken actions
Willie	OK. Hay uno, dos, tres, cuatro, cinco, seis… *(There are one, two, three, four, five, six…)* Oh boy… Es como un cosa de seis… (*It's like a thing of six…)*	Moves finger as if tracing a hexagon in the air. Traces with finger in the air, again.
Calum	¿Es como seis cosas? (*Is it like six things?)*	
Jimmy	¿Puedes dibujarlo para mi? (*Can you draw it for me?*)	
Willie	No puedes dibujarlo, pero puedes verlo porque es muy difícil describir. Es como esto. (*You can't draw it but you can see it because it's hard for me to describe it. It's like this.)*	Starts folding pipe cleaner. Calum and Jimmy lean over and they each start folding their pipe cleaners as they observe.
Calum	¿Es un triángulo? *(Is it a triangle?)*	
Willie	Es más o menos como un triángulo. Es como varios triángulo juntos. (*It's kind of like a triangle. It's like many triangles together.*)	All three students stop folding the pipe cleaners.
Calum	¿Como un cuadrado de dos triángulos? (*Like a square made out of two triangles?)*	
Jimmy	Hush it up! Let him show us.	Jimmy picks up Willie's pipe cleaner.

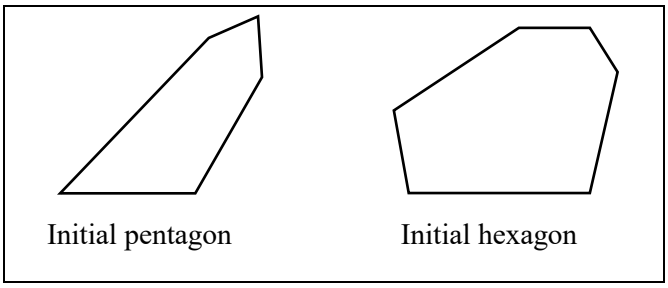
Student silence that fosters multimodality. The multimodal nature of mathematical activity is evident in this example as Willie combined talk and gestures when he simultaneously counted and traced the shape in the air. He, however, acknowledged that at this point in the lesson it was difficult for him to describe the shape. Silence followed. Far from being an idle moment, Willie diligently manipulated his pipe cleaner trying to make sense of the angles and sides that made up his hexagon. Calum and Jimmy coordinated observation and their own movements reshaping their pipe cleaners. Rather than indicating meaningless imitation, their actions show evidence of intent observation and embodied sense-making. In this case, silence opened up a space for Willie to use multiple modalities to show what he knew about the shape without vocal students interrupting. Willie's initial attempts to describe the hexagon could be interpreted as lack of language, and Jimmy's comment ("*Hush it up!"*) as a power move to silence his classmates. What happened next, however, suggests an alternative interpretation.

Willie continued folding his pipe cleaner. Unlike Calum who continued observing and folding his own pipe cleaner, Jimmy stopped folding and observed quietly. After a couple of attempts and some help (from me), Willie finished his shape. When Calum was done, he ended up with the pentagon represented in Figure 2. Willie tapped with his finger each side of Calum's shape, quietly counting the number of sides, and declared: "Esto no es la figura" (*this is not the shape*). Calum took up Willie's actions by tapping on each side of Willie's shape while saying out loud the numbers from one to six. Then, he did the same with his own shape and stated: "Oh! Son seis de estos líneas" (*Oh! It's six of these lines*), which Willie confirmed enthusiastically. Calum proceeded to rearrange his pipe cleaner and ended up with the hexagon represented in Figure 2. Observing Calum's hexagon Willie said: "Es como la figura, pero no es. Estos líneas son como igual" (*It is like the shape, but it's not. These lines are like the same.)*

In this interaction, when Willie and Calum counted the sides in each other's shapes, they reached an unspoken common understanding: A defining characteristic of their shape was the number of sides. Any other shape with a different number of sides was not their shape.

Figure 2

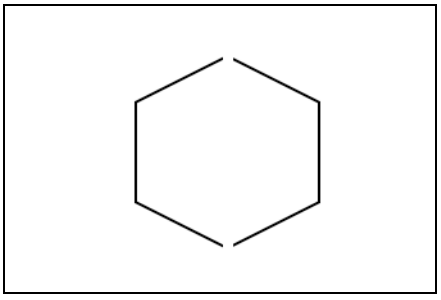
Calum's pipe cleaner shapes.



Student silence that enhances observation. While the previous interactions unfolded, Jimmy had continued to observe quietly. After listening to Willie's last comment challenging whether Calum's shape was their shape, Jimmy grabbed an extra pipe cleaner and announced: "Tengo un idea" (*I have an idea*). He folded one of the pipe cleaners in three parts, rearranging it until the three parts were approximately the same length. Then, he placed the second pipe cleaner over the first one and proceeded to fold it until both pipe cleaners looked the same. Finally, he placed them side by side, as shown in Figure 3. Willie and Calum observed this process. In the end, Willie said "Yes! Eso es la figura" (*Yes! That's the shape*) and Calum simply said "Wow!" as he started to follow a similar process.

Figure 3

Jimmy's hexagon from two pipe cleaners



Jimmy's silence during the part of the task when Willie and Calum counted the sides of their shapes was not an indication of lack of understanding. Instead, intent observation accompanied Jimmy's silent sense-making. Not putting his understanding in words did not interfere

with Jimmy's ability to generate an efficient strategy. His strategy showed that he understood that the shape had six sides and that the sides were the same length. He extended this idea: By using two pipe cleaners, Jimmy showed an understanding of the shape's symmetry. Jimmy's was a silent and generative idea that filled the gap between the information that Willie had and Calum's search for a strategy to rearrange his shape.

Teacher silence that respects student sense-making. The role that the teacher and I played during these interactions involved silence. During small group work, children in this classroom were used to the teacher or I seating next to them and observing quietly witout necessarily adding our own thoughts. When I was observing this small group, it was tempting to intervene. For example, I could have asked Willie questions about the number of sides of his shape to focus the group's attention on defining attributes of their shape. Although questioning and other ways of supporting small group work can be productive, I remained silent. Instead of guiding their exploration of mathematical ideas and imposing language production, my own silence helped me avoid taking over these students' sense-making. In turn, students proved that, when given the chance, they can come up with their own multimodal strategies, and ways to develop and communicate mathematical ideas.

Teacher silence played an important role in reaffirming students' mathematical knowledge authority. Instead of the teacher and I having the final word when students found disagreement or unexpected solutions, we trusted them with the responsibility of reconfiguring their conflicting ideas. Our silence encouraged student-student interactions where children generated and assessed mathematical ideas. We did not, for example, tell Calum that the pentagon he created was the wrong shape and we did not interrupt Jimmy's silence by asking him to put his ideas in words. Teacher silence became part of the coordination of multiple modalities that also included student silence, observation, and movement.

Talking It Up

The second part of the mystery shapes task was a whole class discussion where each group shared and described their shape. Mrs. Abad and I asked questions for students to compare the different shapes. Our questions also inquired about mathematical terminology. It was during this discussion that some students began to put their understanding in words. For example, when Willie's group shared their shape, Willie said that "nuestra es seis de estos líneas" (*ours is six of these lines*). Mrs. Abad asked the class what "these lines" were called. With some scaffolding and modeling from classmates, Willie reformulated his explanation to "nuestra tiene seis lados y todos seis lados son iguales" (*ours has six sides and all six sides are the same*). Excitedly, Jimmy added: "es un 'seisángulo'!" (*it's a 'sixangle'*). Jimmy's coinage of a name for their shape was an entry point to a discussion about how to name shapes, and about the relationship between defining attributes of a shape and the shape's name.

There were several other instances of terminology emerging in this discussion. For example, the word "angle" emerged when Harper, looking at all the shapes that groups had presented, said "Todos son ángulos… Todos tienen ángulos" (*They are all angles… They all have angles*). The word "length" emerged when Juan, describing a trapezoid, said "Dos tienen el mismo longitud de lado y el otro dos la misma longitud" (*Two of the sides are the same length and the other two are the same length*). The idea of "parallel lines" followed when Rose stated that "casi todos [las figuras] tienen líneas paralelas" (*almost all [the shapes] have parallel lines*).

Rather than being a necessary precursor of engagement with powerful mathematical ideas, in the mystery shapes task formal and accurate mathematical language production followed the emergence of ideas in silent ways. Instead of postponing the exploration of mathematical concepts until an idealized stage when students are expected to have mastered a predetermined subset of language, students quietly engaged with and demonstrated nuanced understandings from the beginning of the task. The class broke the silence and collaborated in developing formal mathematical language when the need arose.

Closing Thoughts and Suggestions

Students who are simultaneously learning mathematics and the language of instruction creatively draw on

multiple resources to support sense-making. Interactions around the mystery shapes task illustrated how silence can be one of these resources. Rather than condemning silence as an unequivocal indicator of lack of knowledge and confidence, Willie, Calum, and Jimmy purposefully and productively included silence as one of the modalities they used in this task. Their interactions highlight the importance of agentive use of silence that supports students' self-mediated learning (Blight & Drury, 2015). Teacher silence supported unobtrusive observation that is respectful of bilingual students' strategic use of silence in specific moments and with specific people (Drury, 2013). Teachers can learn from these uses of silence to intentionally decide when eliciting talk is productive and when silence is an alternative that honors students' diverse ways of making sense of ideas.

During the mystery shapes task, the teacher and I trusted students with decisions about their own language use and their own silence. Students decided when and in which language to speak, and the info gap task supported the emergence of other modalities. This flexibility is consistent with research on second language learning that acknowledges that students produce language when they feel an authentic need for it (Gass, 2018). In the mystery shapes task, the need to talk was more compelling during the whole class discussion than during small group work. Even then, teacher silence played an important role, as it was the students who did most of the talking and language modeling. Teacher silence, for example, opened up opportunities for students' lexical inventions (Dewaele, 1998), such as Jimmy's made-up word 'seisángulo' (*sixangle*) that skillfully connected mathematical ideas and terminology.

Ultimately, the mystery shapes task and the interactions around it support the call for teachers to attentively listen to students. In this case, the call is to listen not only to student talk but also to student silence and to avoid the tendency to mistrust interactions that are not regulated by the teacher. Teachers could focus efforts on disrupting specific kinds of student silence that marginalize bilingual learners, instead of attempting to eradicate all silence in favor of premature or unnecessary student talk.

References

Becker, J. R. (1995). Women's ways of knowing in mathematics. In P. Rogers, & G. Kaiser (Eds.), *Equity in mathematics education: Influences of feminism and culture* (pp. 163-174). The Falmer Press.

Bligh, C., & Drury, R. (2015). Perspectives on the "silent period" for emergent bilinguals in England. *Journal of Research in Childhood Education, 29*(2), 259-274.

Brisk, M. E. (2011). Bilingual education. In E. Hinkel (Ed.), *Handbook of research in second language teaching and learning, Vol. II* (pp. 7-24). Routledge.

Dewaele, J.-M. (1998). Lexical inventions: French interlanguage as L2 versus L3. *Applied Linguistics, 19*(4), 471-490.

Drury, R. (2013). How silent is the 'Silent Period' for young bilinguals in early years settings in England? *European Early Childhood Education Research Journal*, *21*(3), 380-391.

Escobar Urmeneta, C. (2013). Learning to become a CLIL teacher: Teaching, reflection and professional development. *International Journal of Bilingual Education and Bilingualism*, *16*(3), 334-353.

Gass, S. M. (2018). *Input, interaction, and the second language learner*. Routledge.

Foote, M. Q., & Lambert, R. (2011). I have a solution to share: Learning through equitable participation in a mathematics classroom. *Canadian Journal of Science, Mathematics and Technology Education, 11*(3), 247-260.

Larsen-Freeman, D. (2011). *Techniques and principles in language teaching*. Oxford University Press.

Li, D. C. S. (2015). L1 as semiotic resource in content cum L2 learning at secondary level – empirical evidence from Hong Kong. *International Journal of Bilingual Education and Bilingualism*, *18*(3), 336-344.

Lubienski, S. T. (2000). A clash of social class cultures? Students' experiences in a discussion-intensive seventh-grade mathematics classroom. *The Elementary School Journal*, *100*(4), 377-403.

Martínez Hinestroza, J. (2018). Language as resource: Language immersion mathematics teachers' perspectives and practices. In R. Hunter, M. Civil, B. Herbel-Eisenmann, N. Planas, & D. Wagner (Eds.), *Mathematical discourse that breaks barriers and creates space for marginalized learners* (pp. 85-100). SENSE Publications.

O'Halloran, K. L. (2005). *Mathematical discourse: Language, symbolism and visual images*. Continuum.

Radford, L., Bardini, C., & Sabena, C. (2007). Perceiving the general: The multisemiotic dimension of students' algebraic activity. *Journal for Research in Mathematics Education, 38*(5), 507-530.

Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. How would an info gap task that promotes productive silence look like when exploring other ideas, such as numbers and operations, measurement, or algebraic thinking?

2. How can teachers intentionally and explicitly incorporate silence as a pedagogical resource in the mathematics tasks they design?

3. Which other pedagogical resources that could support multilingual learners' mathematical sense-making do we tend to overlook?

4. How can teachers differentiate productive silence (i.e., silence as a pedagogical resource) from silence that needs to be interrupted (i.e., silence that marginalizes)?

The mission of TODOS: Mathematics for ALL is to advocate for equity and high quality mathematics education for all students—in particular, Latina/o students.

Five goals define the activities and products of TODOS: Mathematics for ALL

1. To advance educators' knowledge and ability that lead to implementing an equitable, rigorous, and coherent mathematics program that incorporates the role language and culture play in teaching and learning mathematics.

2. To develop and support educational leaders who continue to carry out the mission of TODOS.

3. To generate and disseminate knowledge about equitable and high quality mathematics education.

4. To inform the public and influence educational policies in ways that enable students to become mathematically proficient in order to enhance college and career readiness.

5. To inform families about educational policies and learning strategies that will enable their children to become mathematically proficient.